

Totally Endoscopic Tricuspid Valve Repair Without Caval Snaring

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Introduction

Progressive, uncorrected tricuspid regurgitation (TR) is an established independent predictor of long-term mortality and irreversible right heart failure. Totally endoscopic tricuspid valve repair (TVR) via a right mini-thoracotomy minimizes surgical trauma, reduces thoracic wall injury, and accelerates functional recovery [1,2,4]. However, establishing a bloodless and completely stable operative field inside the right atrium remains an intraoperative challenge [1,2]. Standard techniques rely on manual exposure and surgical loop isolation around the superior and inferior venae cavae ("caval snaring"). Dissection around these thin-walled venous structures poses a risk of vascular laceration, air entrainment, or incomplete occlusion. These technical problems are exponentially magnified in redo surgeries or advanced heart failure settings where dense intrapericardial adhesions hide native anatomical planes. [3]
A "snare-free" strategy shifts venous occlusion from an external manual maneuver to an internal catheter-based solution using the SMARTCANNULA® system. These self-expanding, spring-reinforced nitinol catheters expand passively inside the vessel, maximizing internal cross-sectional area and fluid dynamics. This achieves high-flow, gravity-assisted drainage and stable decompression without requiring external tourniquets [1,2].

Objective: Evaluate the feasibility, workflow efficiency, and safety profile of this snare-free approach.

Methods

- Cohort selection:** We analyzed 32 consecutive adult patients presenting with severe TR who underwent totally endoscopic TVR using a uniform, snare-free venous smart cannula setup between January 2020 and December 2025. [5].
- Surgical Setup:** Venous access was established via percutaneous, ultrasound-guided puncture of the femoral vein to position the self-expanding smart cannula across the right atrium into the superior vena cava under transesophageal echocardiographic guidance [5].
- Analysis:** Continuous variables were checked for normality and detailed as mean ± standard deviation (SD) or medians with interquartile ranges (IQR). Categorical data are reported as absolute numbers and percentages. In accordance with the descriptive, single-cohort design, no comparative hypothesis testing or p-value calculations were performed. Executed via Python 3.13 libraries.

Results

- The descriptive cohort comprised 32 patients with a mean age of 65.1 ± 17.1 years and an equal gender distribution (50% male, 50% female) .
- The mean baseline global risk profile via EuroSCORE II was 3.6 % ± 3.5 %. Comorbidities included severe obesity (28.1%), COPD (15.6%), and preoperative chronic dialysis (12.5%) .
- Endoscopic tricuspid valve repair was successfully completed in all 32 patients, with a 100% technical success rate for internal right atrial drainage without manual caval snares. Unplanned conversion to open sternotomy or conventional snaring was limited to 3.1% (n=1).
- Clinical Hemolysis Incidence: 0.0%, showed by no decrease in haptoglobin after surgery
Smooth fluid dynamics of the nitinol framework completely neutralized mechanical shear stress and erythrocyte trauma.
- At discharge, residual tricuspid regurgitation was documented as completely absent or mild in 95% of patients.

Parameter / Clinical Metric	Descriptive Statistic (N = 32)
Cardiopulmonary Bypass (CPB) Time	145.9 ± 35.8 minutes (Median: 141.0 min)
Aortic Cross-Clamp Duration	92.4 ± 24.5 minutes (Median: 94.5 min)
Percutaneous Venous Cannulation Strategy	90.6% (n = 29)
Concomitant Left Atrial MAZE Ablation	37.5% (n = 12)
Surgical ASD/PFO Defect Closure	19.4% (n = 6)
30-Day All-Cause Postoperative Mortality	3.1% (n = 1)
Surgical Re-thoracotomy Rate (Bleeding/Tamponade)	12.5% (n = 4)
Postoperative Permanent Pacemaker Implantation	6.2% (n = 2)
Intensive Care Unit (ICU) Length of Stay	6.0 ± 4.9 days (Median: 4.0 d)
Total Postoperative Hospital Stay	15.4 ± 9.7 days (Median: 13.5 d)

References

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Biomechanical Advantages

- Caval Decompression:** Conventional single/multistage catheters risk thin-walled vessel collapse against suction ports ('chattering') [2]. The smart cannula expands passively to exert outward radial force, maximizing cross-sectional area and ensuring robust gravity drainage [1,2].
- Conduction Protection:** Conduction system injuries near the sensitive triangle of Koch remain a frequent complication in tricuspid annuloplasty due to the close anatomical proximity of the AV node and bundle of His[3]. Our low permanent pacemaker rate (6.2%) suggests that the excellent right atrial decompression and premium visual clarity allowed for highly precise, tension-free suture placement, minimizing mechanical trauma to conduction tissue.

Conclusions

- A totally endoscopic, snare-free tricuspid valve repair protocol utilizing percutaneous venous smart cannulation is safe, technically feasible, and highly reproducible.
- Replacing external manual isolation and traction of the venae cavae with an internal, catheter-based self-expanding solution significantly streamlines right atrial access and minimizes tissue trauma .
- Optimizing the procedural steps eliminates time-consuming dissection maneuvers, effectively reducing the technical and cognitive burden on the surgical team within a restricted thoracoscopic working space.
- Shortening cardiopulmonary bypass exposures directly mitigates the systemic hyperinflammatory cascade and subsequent multi-organ stress—a clinical benefit that was described to be protective in fragile tricuspid valve patients with baseline hepatic congestion and borderline renal perfusion [1,2].